PROPOSAL

Submitted To

LOUISIANA TECHNOLOGY INNOVATION FUND

By

Louisiana State University

August 12, 2003

I PROJECT TITLE:

Exploiting Linux Services in Louisiana

II PROJECT LEADER

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III EXECUTIVE SUMMARY

LSU requests $999,768 to develop a robust, scalable environment to accelerate and facilitate the evaluation and deployment of Linux services and applications within public-supported entities in Louisiana. The move to open standards and open source is changing the world of information technology in the public and private sectors and higher education. Linux, once considered "disruptive technology" by IBM, is the leading example of open source software that implements open standards. Linux is becoming widely available on multiple hardware platforms and is now an option for many proprietary applications. Linux combined with virtualization technology offers a possible opportunity to combat the growing cost of supporting burgeoning, complex information technology infrastructures and the increasing dependence on a proprietary software platform. Recently, Linux was characterized in Computer World as a "Microsoft license killer." Louisiana has been slow in embracing this emerging technology. The intent of this proposal is to maximize the opportunity to accelerate innovation with Linux, to limit dependence on proprietary systems and to focus on total cost of ownership issues.

The initial goal will be to create a production Linux server testbed in early 2004 for the following purposes:

Provide an established environment for State agencies to evaluate potential Linux system software and applications.

Provide a pilot line of service to implement common Linux-based functions including webserving, file and print serving, listserv support, virtual computers for classroom instruction, distributed data base serving, e-mail, server and workload consolidation, etc.

Provide a pilot line of service to offer State agencies additional computing resources on a temporary basis and failover services as required for existing services.

IT professionals in state government and higher education are expected to provide comprehensive services and respond quickly to changing requirements. Services must be responsive, web-based, resilient, 7x24, secure, sexy, etc. while being cost-effective. As the complexity increases, the servers proliferate and the system management becomes increasingly difficult. LSU is completing a Linux research project with IBM at the end of 2003. In the course of this three year project, we have gained experience in all aspects of Linux system management in a virtual server environment. The opportunity is here to leverage that experience with the State IT professionals and expedite the deployment of Linux services where appropriate.

IV DESCRIPTION OF THE PROJECT

A. Project Narrative

LSU proposes to develop a robust, scalable environment to accelerate and facilitate the evaluation and deployment of Linux services and applications within public-supported entities in Louisiana. The move to open standards and open source is changing the world of information technology in the public and private sectors and higher education. Linux, once considered "disruptive technology" by IBM, is the leading example of open source software that implements open standards. Linux is becoming widely available on multiple hardware platforms and is now an option for many proprietary applications. Linux combined with virtualization technology offers a possible opportunity to combat the growing cost of supporting burgeoning, complex information technology infrastructures and the increasing dependence on a proprietary software platform. Recently, Linux was characterized in Computer World as a "Microsoft license killer". Louisiana has been slow in embracing this emerging technology. The intent of this proposal is to maximize the opportunity to accelerate innovation with Linux, to limit dependence on proprietary systems and to focus on total cost of ownership issues.

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The testbed is envisioned as a production Linux server environment with sufficient capacity to assess performance and scaling issues, as well as the real-world aspects of system management such as security, backup, recovery and server consolidation. Strategic system software will be available including DB2, WebSphere and Domino. With the testbed, State agencies will have the

ability to access Linux production quality technology without the requisite startup effort. State agencies will have the ability to deploy new functionality quickly and incrementally. State agencies will have the flexibility with the virtualization features to extend capacity on an interim basis and develop failover services for critical functions during production outages.

The project will rely extensively on state-of-the art virtualization technology provided by z/VM on the IBM z800 platform. The Linux services will be offered via virtual servers in a separate logical partition of the LSU z800 hardware. The configuration includes two dedicated processors (approximately 340 MIPS) and 8 gigabytes of memory. Storage access will be available on the existing IBM Enterprise Storage Server (SHARK). Network connectivity will be via the Internet where LSU has OC-3 (155 mbits) connections to LaNet, Qwest and I2. The strategy of the design is to leverage the LSU investment in hardware, software and people to minimize the costs. The hardware will be housed in the LSU Frey Computing Services Center – a modern facility occupied in 1995 – and will be available 7x24x365.

The targeted users for the proposal are the IT departments, large and small, of Louisiana State government challenged to deliver services to the citizenry. Specifically, the Dept. of Social Services has immediate Linux software needs that this proposal addresses and included as an attachment is a letter of support. In an informal poll of IT Directors, there is a growing need for the ready availability of Linux resources and the need for a testbed. Similarly, on the LSU campus there is a need in the area of economic development as described in a letter of support by Dr. Tom Ray from Engineering and the ongoing need for dynamic virtual Linux servers in the classroom, particularly in Computer Science, as described in a letter of support from Dr. Sithmar Iyengar.

B. Use of Innovative Technology

Linux is now at the forefront of a rapidly changing IT environment and is serving as a change agent in the move to open systems. So, the use of Linux alone is not considered particularly innovative. However, the innovative aspects of this project are at least two-fold as follows:

Virtualization – The use of virtualization technology to provide Linux services shared by multiple users and agencies on the same hardware. The concept provides the opportunity to consolidate expensive resources and provide secure access.

Agency Sharing – The sharing capability provided by Linux virtualization offers the opportunity to simplify the process of making strategic decisions concerning: application compatibility and performance, system stability and reliability, and system management difficulty. Additionally, the sharing will foster cooperation, elevate the skills of state IT professionals and lower the risk of modernizing agency IT infrastructure.

LSU is not aware of another state or university that has developed a shared testbed facility as suggested in this proposal. However, certainly other states and universities, as well as federal governments worldwide, are in various stages of deploying Linux services and infrastructures ranging from the desk top to servers to high-performance computing. Our goals are consistent with other governmental and educational efforts to move toward open standards to control costs and eliminate proprietary solutions.

C. Multi-agency Application or Portability to Other Agencies

This proposal is tailored to provide interim production quality Linux services to all State agencies via the Internet. The Dept. of Social Services has identified an immediate need for use of the testbed. Other State agencies have indicated the need for the ability to look at specific Linux applications or the need to offer services before the IT infrastructure is operational. LSU will publicize the availability of the testbed to all agencies through the Council of Information Services, offer informational material and seminars, and administer user accounts.

As an open platform, the application software can be ported to other IT infrastructures including multiple hardware platforms.

D. Benchmarking Partners and/or Best Practice References

The future of Linux as a strategic platform in the marketplace is still uncertain. However, in the past three years, strategic applications based on Linux have been adopted by public and private entities. According to IDC, Linux is the fastest growing operating system and, according to Gartner, Linux is the number 2 server operating system. According to IBM Research, 80% of Linux users are running Linux in production or have adopted it as a corporate platform. According to Gartner, "by 2006 Linux will be a key foundation for a strategic, cross-development platform environment … while creating a powerful alternative to Windows.NET." In early August, 2003, IBM and SuSE attained Common Criteria Security Certification from the International Standards Organization. In our estimate, the drivers for this growth and success are accelerated innovation, security, vendor independence and total cost of ownership.

In reviewing the use of Linux, we found strategic initiatives at the federal, state and local level within the United States and worldwide. But we found no evidence of a Linux testbed to facilitate the unbiased evaluation of Linux solutions and the incremental deployment of Linux-based services. At LSU, the IT infrastructure is complex and the application requirements are 7x24. Making strategic changes is a long-term process that must insure continuity of services in a cost-effective manner. The management requirement was once described as the Law of the Wingwalker, which is – "Don't let go of what you've got hold of until you've got hold of something else". LSU's interest in the availability of virtual Linux services is based on the need to push forward in a non-disruptive manner. The State IT environment is similarly complex and the innovation of this proposal is to make Linux readily available to State agencies without the requisite startup effort.

E. Long-range Planning

LSU is committed to providing quality computing services to the user community. Included in the campus master plan is the aspiration to be a leader in the application of information technology. LSU is already in the process of exploring the use of virtualization technology and Linux system and application services across multiple hardware platforms. LSU is completing a three year joint research project with IBM on this technology. The proposal is consistent with LSU strategic aspirations. This project seeks the opportunity to leverage the existing investment to accelerate State evaluation and deployment of Linux services.

F. Performance Goal

The ultimate measure of the success of the project will not be in the widespread deployment of Linux services with State government. The success will be in providing IT decision makers with the opportunity to make intelligent decisions on where to deploy Linux and accelerating that deployment where appropriate. Based upon our assessment of demand, over a three year period, we would define success by attaining the following usage measures:

Number of State entities using the services - 15
Number of test Linux images created - 200
Number of production Linux images – 75
Service availability – 98%

G. Technical Approach

From a technical perspective, the goal of the project is to deliver managed, scalable, and robust Linux services to a statewide community over the existing network infrastructure.

We will use virtualization to reach these goals. Virtualization technology has recently grown in popularity. With modern hardware performance, the overhead for "virtualizing" computers is more than offset by the scalability and individual performance of the virtualized machines. System management is simplified and server consolidation is achieved by eliminating a large amount of hardware. Modern networks permit these virtual machines to appear as standard independent Linux servers.

The virtual machines will run the Linux operating system. Over the course of our research project, we used Linux distributions from both SuSE and Red Hat, and experimented with building our own Linux kernel using IBM's hardware specific modules with the standard Linux kernel source code. Overall, we have been disappointed in the level of support from Red Hat for this platform, and have been pleased with SuSE's approach of bundling the Logical Volume Manager (LVM) and enhanced installation, maintenance, and support tools into their mainframe product. We plan to use SuSE's latest distribution for this project. SuSE worked with IBM on the initial port of Linux to the mainframe, has kept its product updated, is very active in the support community, and their distribution is used for most benchmarks of vendor products in this environment.

The hardware platform of choice for this project is the IBM z/800 eServer zSeries Enterprise Server. As LSU is in the process of upgrading its existing 9672-R36 mainframe to a model z/800, we will take advantage of this upgrade and add additional resources to support the z/VM-Linux environment in a separate Logical Partition (LPAR). We will add two Integrated Facility for Linux (IFL) processors to the z/800 platform and allocate them exclusively to this LPAR. The IFL is a standard z/800 central processor tailored to run only Linux and the z/VM operating system. With the addition of 8 gigabytes of real memory and outfitted with FICON and OSA adapters, the z/800 becomes a robust Linux platform with the ability to move data quickly and efficiently. See figure T-1.

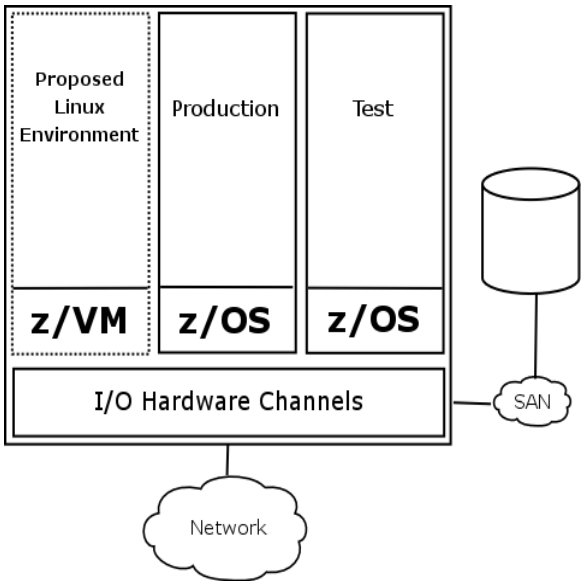

Figure T-1

IBM's Virtual Machine for zSeries (z/VM) operating system will manage the Linux machines. This operating system has a long history of stability and efficiency, and has several new features designed to enhance its ability to support Linux as a guest operating system.

z/VM allocates the hardware processors, memory, disk storage, and network resources of the underlying hardware to each Linux machine as needed. From the Linux perspective, each machine

has its own set of resources independent of any other machine. Using z/VM, a standard Linux machine can be cloned within minutes to create any number of similar machines, each with its own identity, network address, and allocation of resources as needed. Where practical, the physical resources are shared among the machines, maximizing usage of the available hardware. An example is the use of the IFL processors. Stand alone Linux computers have a high level of idle CPU cycles, whereas the virtual Linux machines under z/VM share those cycles among themselves as needed.

The new Hipersockets facility in z/VM acts as a memory based virtual network device, allowing the creation of subnetted Local Area Networks (LANs) among the Linux machines at memory access speeds. The open source Zebra routing utility, running on one or more Linux images, provides dynamic network routing to these guest LANs. By using dual OSA gigabit network cards in the LPAR, access to the outside world is quick and efficient, with redundant paths. See figure T-2.

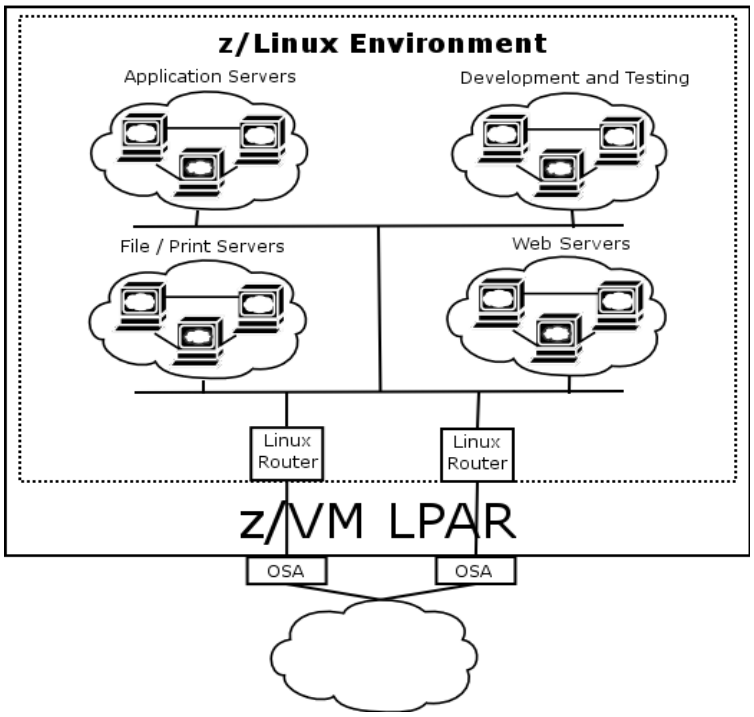

Figure T-2

For disk storage, we will leverage LSU's investment in IBM's Enterprise Storage Server (ESS) technology by adding 4.64 terabytes to one of the existing storage servers. Redundant Fiber channel access from the z/800 mainframe assures optimum disk I/O performance. z/VM manages this raw storage capacity by creating virtual disks of various sizes as needed by the Linux machines. Within each Linux machine, the open source Logical Volume Manager (LVM) utility from Sistina is bundled with the SuSE distribution and is used to create virtual volumes of arbitrary size from the virtual disks supplied by z/VM.

Where possible, we plan to configure the Linux filesystems containing the operating system and utilities as read-only z/VM minidisks. This reduces the amount of disk storage needed since many Linux machines will share a common set of these resources. Additionally, it minimizes exposure to hacking practices, such as root kits which modify Linux system components, since these filesystems are write-protected at the underlying z/VM level.

We plan for a multi-tiered system management approach for this architecture. At the z/VM level, standard tools are available within the operating system for maintenance and support. However, we anticipate the need for third party management tools designed to support the specific combination of Linux under z/VM. These tools simplify the creation, upgrade, deletion, management, and performance monitoring of the Linux machines from the z/VM environment. At the Linux level, utilities such as Big Brother, Tivoli Storage Manager, cpint, and others simplify the management and monitoring of each machine and can alert appropriate personnel when conditions warrant. Several Linux machines will act as administration control points, providing central logging, message routing, and access to common utilities.

At the application level, we will offer several standard services provided by the Linux environment and included in the SuSE distribution for this platform. One of these is web hosting using the Apache open source server, the most popular web server platform in use today. Web servers can be cloned as needed from a standard template image, facilitating server consolidation and rapid deployment of this popular function. The Samba suite of emulated Windows server functions, also open source, will provide file and print network services from the Linux environment, promoting interoperability with existing architectures.

In the commercial arena, we will deploy Lotus Domino 6.5 and WebSphere for application development and hosting, and DB2 for developing and testing RDBMS services.

We address recoverability in two major areas, at the z/VM level and at the Linux virtual system level. For z/VM, standard best practices will be implemented, with weekly full backups of the z/VM environment and ad hoc backups of changed components, such as the user directory, as needed. At the Linux virtual machine level, the Tivoli Storage Manager Backup/Archive client will be assembled into each system template so that each Linux virtual machine can automate its backups overnight to the LSU central repository.

From our experience, this architecture provides a scalable, commercial grade platform with which to offer the latest in Linux server technology to publicly supported entities in the state of Louisiana.

H. Implementation Approach

The implementation schedule is ambitious because of the staff expertise already gained with the current z/Linux project in the area of consolidating production servers. The intent is to build upon the existing experience to expedite the effort. Assuming funding by September 15, 2003, the plan is to have the hardware installed over the Thanksgiving holidays and the software ready for the pilot phase by the end of the year (2003). This schedule is consistent with LSU plans to replace the IBM 9672-R36 processor complex with the z800 at Thanksgiving. The pilot phase will include collaborating with State IT personnel to design and implement the baseline configurations for web servers, file/print servers, and the other basic Linux services that will be offered, and to test out and make recommendations for the use of the commercial software packages to be offered, such as Domino, DB2, and WebSphere. By the end of the first quarter, 2004, the full range of services will be available as needed. Seminars describing the services and how to use them will be presented starting in the spring 2004.

	Year 2003	Year 2004									
	S	O	N	D	J	F	M	A	M	J	J	A	S
* Bid, order and receive hardware	XXXX												
* Prepare site		XX											

* Identify and plan pilot phase XXX
* Install and test hardware XXX
* Install software XXXX
* Prepare management environment XXX
* Pilot phase XXXXXX
* Prepare/Present state agency seminars XXXXXX
* General Availability of Linux Services XXXXXXXXXXX……..
* Project assessment XXX

The services provided by this project will be available for three years.

I. Assessment of Risks

LSU has experience and a successful record in developing, maintaining and supporting large-scale IT projects and in managing grant funds. There is a clear demand for assessment of the viability of deploying and scaling Linux services at the State level. The proposed architecture is reasonable and strategic for these purposes. Based upon our almost three years experience with the technology, we are confident we can successfully deploy robust Linux services. This innovative approach for providing virtual Linux services should streamline the process of evaluating all aspects of making cost-effective decisions on the viability of Linux in Louisiana State government.

J. Integration with Existing Technologies

LSU is able to propose this ambitious project only by taking full advantage of the strengths of the existing IT infrastructure. This concept is designed to deploy innovative services by leveraging LSU's current investments in technology and staff expertise to the maximum. The proposed additional processor capacity will be appended to the existing processor complex. The Linux and z/VM software systems have already been installed on the current hardware as a result of a research project completing December, 2003. The proposed disk storage is an extension of the existing multi-platform SAN environment and will be incorporated into current production storage management procedures. The network access will be provided via the existing high-speed campus backbone without need for additional expense. All operational support will be provided by the current Computing Services operations staff 7x24x365. And, the technical staff is enthusiastic about the opportunity.

K. Project Budget and Costs

1. Equipment

IBM z800 Linux Bundle: The pricing was developed using a bundle of hardware and software including the following:

** Two Integrated Facility for Linux (IFL) processors for the z800 server
** Eight gigabytes of memory to be shared by the processors
** Four fiber channels to connect to the SAN
** Two OSA adapters to connect to the network
** z/VM V4 and 3 years of support subscription
** Three years of hardware maintenance

Disk Storage: Includes 4.64 terabytes of online storage as an upgrade to existing LSU SAN (Enterprise storage SHARK hardware), including four 8 packs of 145 GB disks and flash copy for backup. This storage will be used for the Linux virtual systems, including user storage and z/VM system requirements. Purchase includes 3-year warranty.

Ficon Channels for Enterprise Storage: Four Ficon channels for high-speed connection from the disk hardware to the processor complex. The current configuration does not provide adequate connectivity. Maintenance included in the warranty.

ESCON Converter for 3480 Tape Hardware: Optica ESCON converter for z800 interface to IBM 3480 tape drives for z/VM logical backups.

Equipment Cost Summary:

Item	Quantity	Unit Price	Total
IBM z800 Bundle	1	$525,000	$525,000
Disk Storage (4.64 TB and flash copy)	2	$126,984	$253,968
Ficon Channels for Disk Storage	4	$9,800	$39,200
Escon Converter for 3480s	1	$6,500	$6,500
Total			**$824,668**

2. Software

z/VM: z/VM software and support included in the hardware bundle.

SuSE Maintenance and Distribution: SuSE is the open source Linux operating system to include software distribution on CDs, documentation, patches and updates for three years, as well as vendor support 7x24x365 for three years on two processors.

WebSphere Application Server for Linux: WebSphere enables access to production applications to include initial license ($9K) and maintenance ($3K) for the second and third year on two processors.

DB2: IBM relational data base software to include initial license ($26.5K), maintenance and support ($5.3K) for the second and third year on two processors.

Domino: Enterprise messaging software priced at $76 per user including year of support and maintenance. Subsequent maintenance and support is $21 per year. Licensing covered through existing LSU software agreement. Estimate 100 user licenses over a 3-year period for an approximate total of $10,000.

Cost Summary:

Item	Quantity	Unit Price	Total
SuSE maintenance and Distribution	1	$105,000	$105,000
WebSphere	1	$15,000	$15,000
DB2	1	$37,100	$37,100
Domino	1	$10,000	$10,000
Total			**$167,100**

3. Telecommunications

Will use existing LSU network capability.

4. Professional/Contracted Services

None

5. Other

Training: Funds are included to send two IT professionals to a one-week training session on Linux system management.

Cost Summary:

Item	Quantity	Unit Price	Total
Linux Training Session	2	$4,000	$8,000
Total			**$8,000**

V FUNDING REQUESTED

There are no external funding sources for this project

Funding Category	Total Cost	Other Sources	Funding Requested
Equipment	$824,668	$0	$824,668
Software	$167,100	0	$167,100
Telecommunications	0	0	0
Professional Services	0	0	0
Other	$8,000	0	$8,000
Total	**$999,768**	**$0**	**$999,768**

Note – LSU commitment of infrastructure and personnel not included in figures.

VI COST/BENEFIT ANALYSIS

From a strategic perspective, every State entity should be exploring how and if Linux will play a role in the delivery of key services to their constituents. The z/Linux testbed is intended to facilitate the opportunity to explore these possibilities. Based on LSU experience, exclusive of the hardware and software costs, a minimum of 12 people-months is required to establish an initial Linux environment replete with security, appropriate system management procedures, disaster recovery, etc. The difficulties increase if the technology is new to the staff. Therefore, significant cost and personnel resources and duplication of effort are avoided by leveraging this investment in Linux. We have not tried to quantify those savings. Similarly, we did not attempt to quantify the savings associated with sharing of knowledge and resources, improved decision-making, faster deployment of services, etc.

The only recurring operational costs are software licenses and hardware maintenance, some of which are rolled into the initial hardware acquisition. LSU intends to use existing systems programming personnel and infrastructure leveraging concurrent efforts to deploy Linux services and consolidate servers on the campus.

Expenditure Increase (Decrease)

STATE COSTS	**2003-04**	**2004-05**	**2005-06**
Personnel Services			**$65,000(1)**
Operating Services	**$74,500(2)**	**$46,300(2)**	**$46,300(2)**
Professional Services			
Other Charges	**$4,000(3)**	**$4,000(3)**	
Equipment	**$824,668(4)**		
TOTAL	**$903,168**	**$50,300**	**$111,300**

(1) – New anticipated system administrator position (LSU Funds)
(2) – Software acquisition, support, and maintenance (LTIF Funds)

(3) – Linux training (LTIF Funds)
(4) – Hardware acquisition (LTIF Funds)

STATE COSTS	**2003-04**		**2004-05**		**2005-06**	
PERSONNEL (By Classification)	**No. Pos.**	**Av. Sal.**	**No. Pos.**	**Av. Sal.**	**No. Pos.**	**Av. Sal.**
Sys. Admin. (1)					1	$65,000

(1) – Anticipate the need for an additional Linux system administrator position during the third year of the project to cope with the growth associated with server consolidation on a large scale. Source of funds is from LSU.

MEANS OF FINANCING FOR ABOVE EXPENDITURES

FISCAL YEAR	**STATE GEN. FUND**	**AGENCY SELF GENERATED**	**RESTRICTED/ OTHER**	**FEDERAL FUNDS**	**LOCAL FUNDS**
2003-04	**$903,168(1)**				
2004-05	**$50,300(2)**				
2005-06	**$111,300(3)**				

(1) – LTIF Funds
(2) – LTIF Funds
(3) – $65,000 from LSU Funds

VII SIGNED STANDARD FORM

All standard proposal forms must be submitted along with a cover letter signed by the Secretary, Undersecretary (or their equivalents) and the Project Manager.

_____ _____
Mark Emmert, Chancellor

_____ _____
Risa Palm, Executive Vice Chancellor and Provost

_____ _____
Jim Bates, Director, Office of Sponsored Programs

_____ _____
Ronald D. Hay, CIO and Executive Director of Computing Services

ATTACHMENTS

Letter of Support - Dr. Sitharama Iyengar, LSU, Chair, Dept. of Computer Science
Letter of Support - Dr. Thomas Ray, LSU, Chair, Dept. of Industrial Engineering
Letter of Support - Mr. Duane Fontenot, IT Director, La. Dept. of Social Services